Gender and Ethnicity Differences in Metacognitive Skills and Problem–solving Ability among physics students in Johor.

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1.0 Introduction

A study on metacognitive skills in relation to problem-solving in physics among secondary school students in Johor, Malaysia is sponsored by Research Management Centre (RMC), UTM under Vot 75161. It has finally completed its data collection and a complete Technical Report is due to be published in January 2007.The study involved a survey on 1300 physics students from nine districts of Johor namely Batu Pahat, Muar, Kota Tinggi, Pontian, Johor Bahru, Segamat, Mersing, Kulai and Kluang. Two well-validated instruments on metacognitive skills and four problem-solving questions on mechanics (Fatin, 2005) were conducted among respondents selected from 9 rural schools and 15 urban schools in Johor using random cluster samplings of form four physics students. The sampling of respondents in this study did not include students from fully residential schools where the "cream" of the Malay students are mostly found. The samples comprised students from daily secondary schools (rural and urban) and premier schools (urban High Schools) in Johor. This paper forms part of the report of the short term research project and focuses only on the development of gender and ethnicity differences on metacognitive and problem-solving skills from three stages of research processes. An indepth literature review related to metacognition and physics problem-solving is discussed fully in Fatin (2005).

2.0 Findings

2.1 Gender differences

In preparation for her master's degree dissertation, Fatin (2005) analyzed data from a sample of 389 Form Four physics students in Johor Bahru which comprised 169 male students and 220 female students. In her study she found that the gender differences for both metacognitive and problem-solving skills were significant (α= 0. 05) in favour of female students (Table 2.1:Stage 1). However, she did not examine the ethnicity differences on both the variables.

In Stage 2, samples from Batu Pahat, Muar, Pontian and Kota Tinggi were included which numbered N=816. This time the result indicated that there were no significant differences in gender for both the variables. However in stage 3 of the study (N=1300), the result showed that female physics students generally had significantly higher level of

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metacognitive skills even though in problem-solving skills there was no significant difference between male and female physics students in Johor (Table 2.1: Stage 3).

Table 2.1: Gender differences (t-test)

Variable	Stage 1: N=389 (α= 0.05)			Stage 2: N= 816 (α= 0. 05)			Stage 3: N=1300 (α= 0. 05)		
Metacognitive Skills	Gender	Mean	Sig.	Gender	Mean	Sig.	Gender	Mean	Sig.
	M=169	96.04	0.05	M=387	105.51	0.07	M=553	98.46	0.00
	F=220	101.53		F=410	108.45		F=578	103.15	
Problem solving in physics	N= 389 (α= 0.05)			N= 816 (α= 0. 05)			N=1300 (α= 0. 05)		
	Gender	Mean	Sig.	Gender	Mean	Sig.	Gender	Mean	Sig.
	M=169	20.63	0.05	M=388	17.01	0.266	M=625	16.31	0.30
	F=220	23.93		F= 413	18.03		F=660	15.39	

2.2 Ethnicity differences

In Stage 2 of the research process (Table 2.2) it was found that there were no significant difference on metacognitive skills among Malay, Indian and Chinese physics students (N=816). However, in problem solving ability there was a significant difference between Malay and Chinese in favour of Chinese students (Appendix A-Part a). Further the Post Hoc Tests indicates that there was no significant difference between Chinese and Indian students and between Malay and Indian students despite the small number of Indian students.

Table2.2 : Ethnicity Difference(oneway ANOVA)

Variable	Stage 2: N= 816 (α= 0. 05)			Stage 3: N=1300 (α= 0. 05)		
Metacognitive Skills	Ethnicity	Mean	Sig.	Ethnicity	Mean	Sig.
	M=512	105.76	0.21	M=750	100.36	0.39
	C=267	109.4		C=332	101.32	
	I=17	102.41		I=50	101.86	
Problem solving in physics	Ethnicity	Mean	Sig.	Ethnicity	Mean	Sig.
	M=512	15.60	0.00	M=854	14.18	0.00
	C=271	20.55		C=363	19.25	
	I=17	15.41		I=66	15.36	

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In Stage 3 (N=1300) of the analysis, the result indicates that there was no significant difference among ethnic groups of physics students in Johor in metacognitive skills. In problem-solving ability Chinese students seemed to excel both the Malay and Indian students. There was no significant difference between the Malay and Indian physics students this time as indicated by the Post Hoc Tests (Appendix A-Part B).

3.0 Implications of the findings

Despite limitations in the sampling of respondents, the analysis of gender and ethnicity in the three stages of the research process elicits a number of significant implications. Firstly, for gender and ethnicity differences we are affirmative of the result in Stage 3. As N is large the significant differences become more stable. As for the result we can generally say that the female students are more involved in monitoring, regulating and evaluating their thinking as they solve problems. However, they are no better than the male students as far as solving physics problem is concerned.

As for the ethnic groups , there were no significant differences in their metacognitive skills. However the low performance of the Malay and Indian students in problem-solving ability should raise concern among physics teachers.

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Appendix A

Part a: Oneway ANOVA
Post Hoc Tests (N=816)

Multiple Comparisons

Dependent Variable: peny.masalah
Tukey HSD

(I) Kaum	(J) Kaum	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Melayu	Cina	-4.954(*)	.763	.000	-6.75	-3.16
	India	.184	2.504	.997	-5.70	6.06
Cina	Melayu	4.954(*)	.763	.000	3.16	6.75
	India	5.138	2.539	.107	-.82	11.10
India	Melayu	-.184	2.504	.997	-6.06	5.70
	Cina	-5.138	2.539	.107	-11.10	.82

* The mean difference is significant at the .05 level.

Part b: Oneway ANOVA
Post Hoc Tests (N=1300)

Multiple Comparisons

Dependent Variable: peny.masalah
Tukey HSD

(I) Kaum	(J) Kaum	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Melayu	Cina	-5.065(*)	.626	.000	-6.53	-3.60
	India	-1.181	1.276	.624	-4.18	1.81
Cina	Melayu	5.065(*)	.626	.000	3.60	6.53
	India	3.884(*)	1.337	.010	.75	7.02
India	Melayu	1.181	1.276	.624	-1.81	4.18
	Cina	-3.884(*)	1.337	.010	-7.02	-.75

* The mean difference is significant at the .05 level.